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Holly

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(54) **APPARATUS AND METHOD FOR WARPING A LOOM**

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(51) **Int. Cl.**
D03D 29/00 (2006.01)

(52) **U.S. Cl.** **139/29**

(58) **Field of Classification Search** 139/29, 139/93–96, 114
See application file for complete search history.

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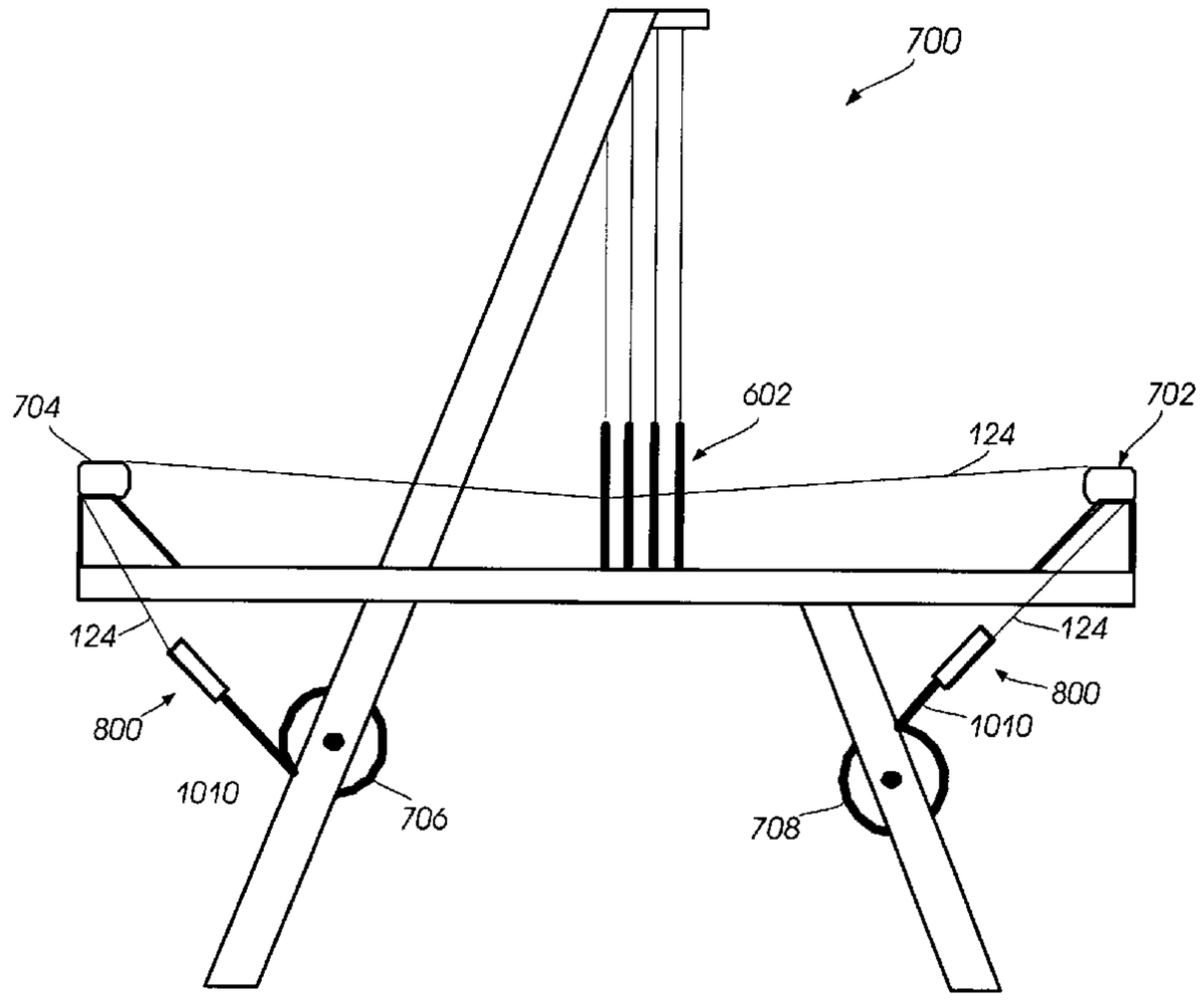
(57) **ABSTRACT**

An apparatus and method for warping a loom includes a heddle with an open or openable break in the circumference of its eyelet that allows insertion and removal of warp thread with simple motions through the break while both ends of the warp threads are fastened to the loom. A warp beam includes a plurality of retaining members that retain parallel strands of warp thread in a spaced relationship to one another. A length of warp thread is wound in consecutive parallel lines between two spaced apart warp beams. The combination of openable heddles and warp beams with warp thread retaining members allow a loom or knitting device to be rapidly set-up, allow for easy correction of mistakes, and for the removal and reloading of the heddles or a weaving project in mid-production.

13 Claims, 9 Drawing Sheets



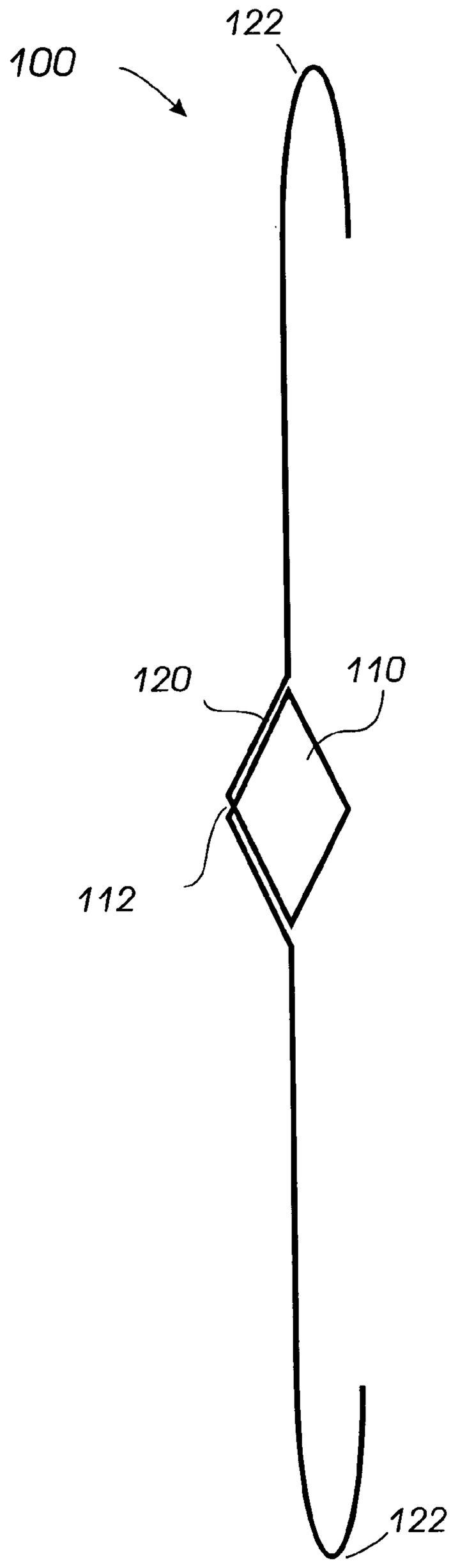


FIG. 1A

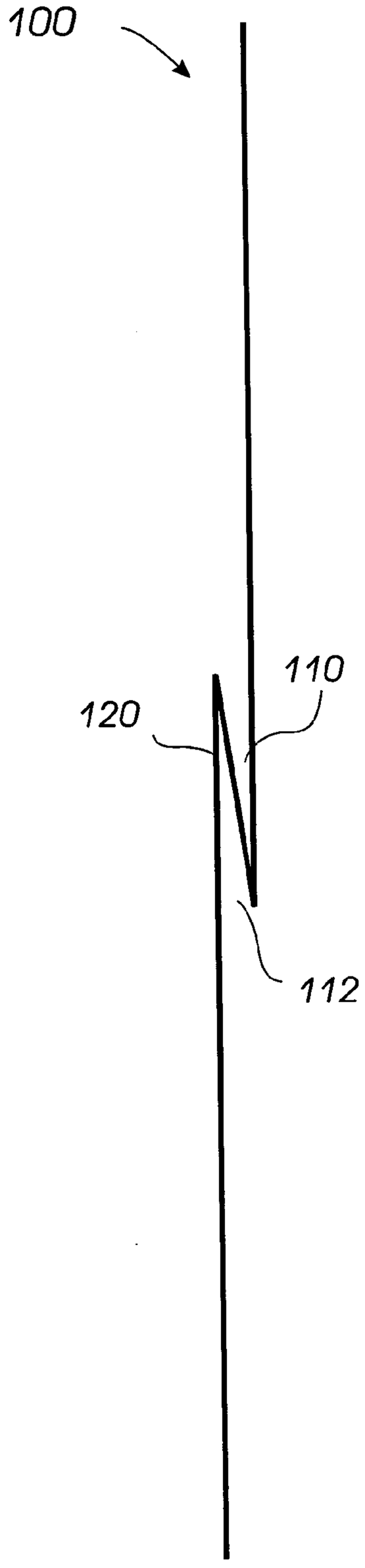


FIG. 1B

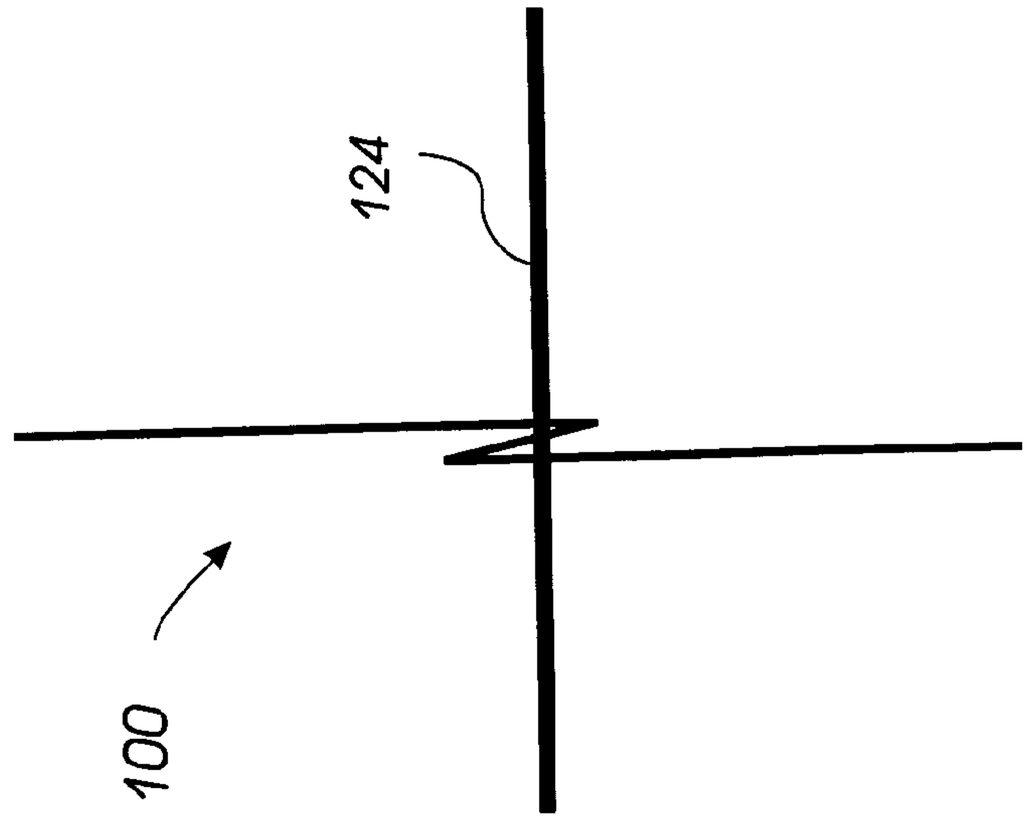


FIG. 1D

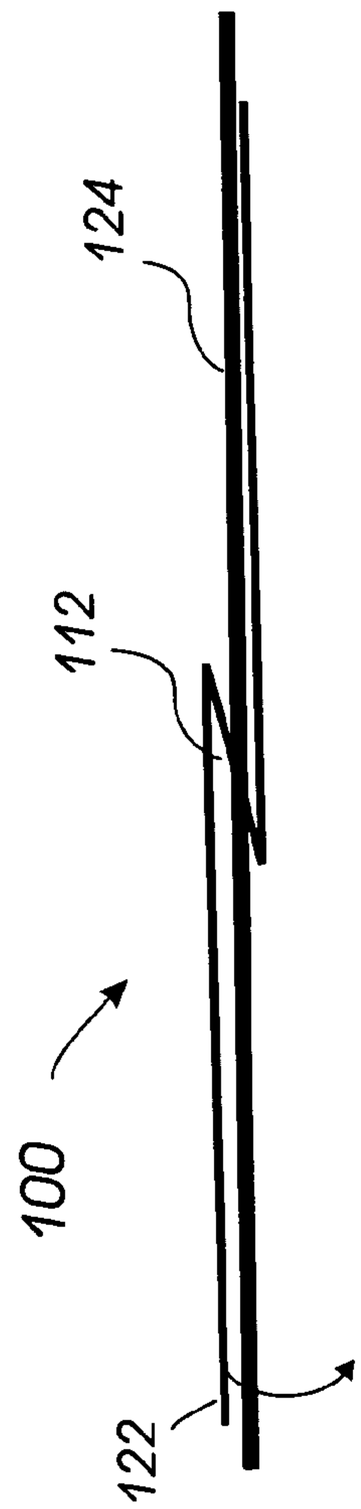


FIG. 1C

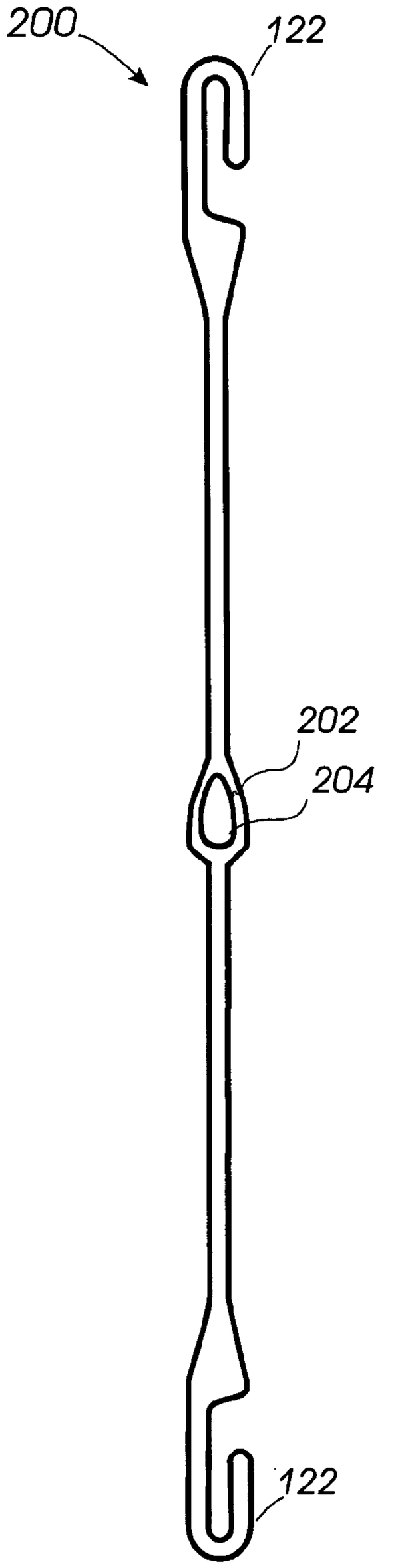


FIG. 2A

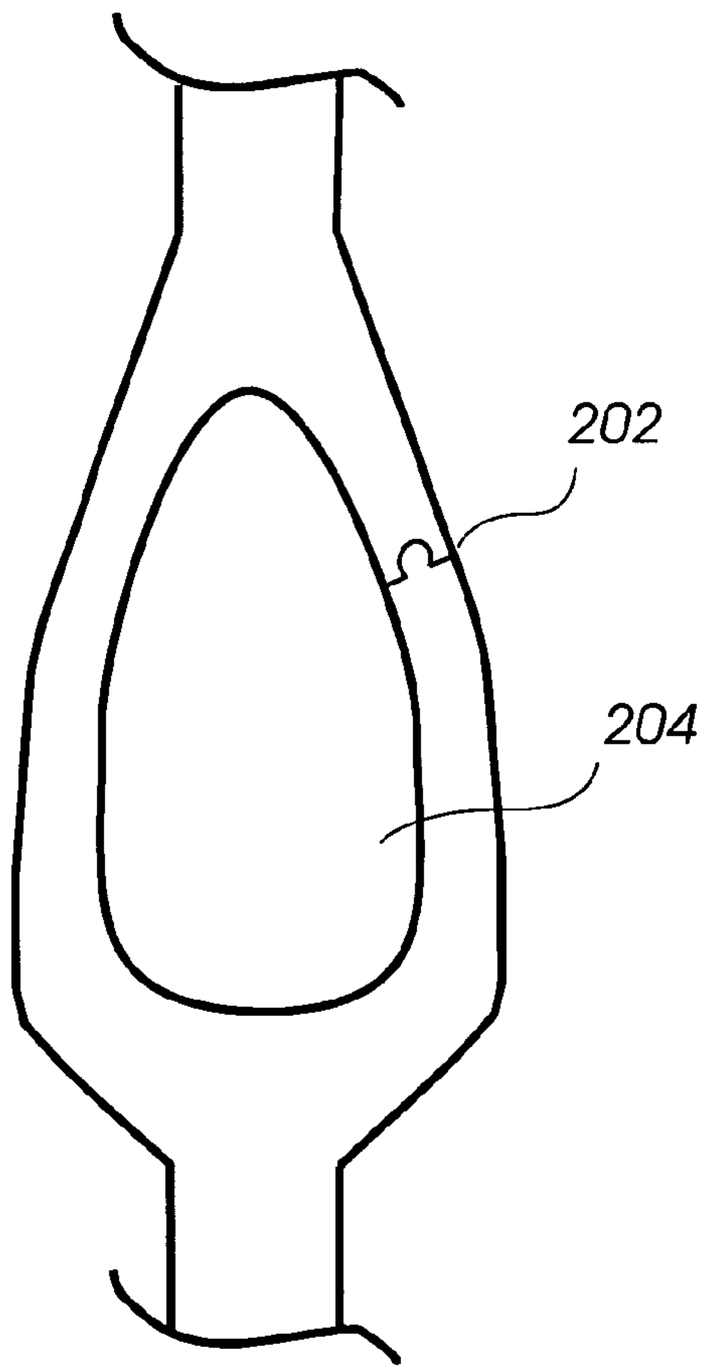


FIG. 2B

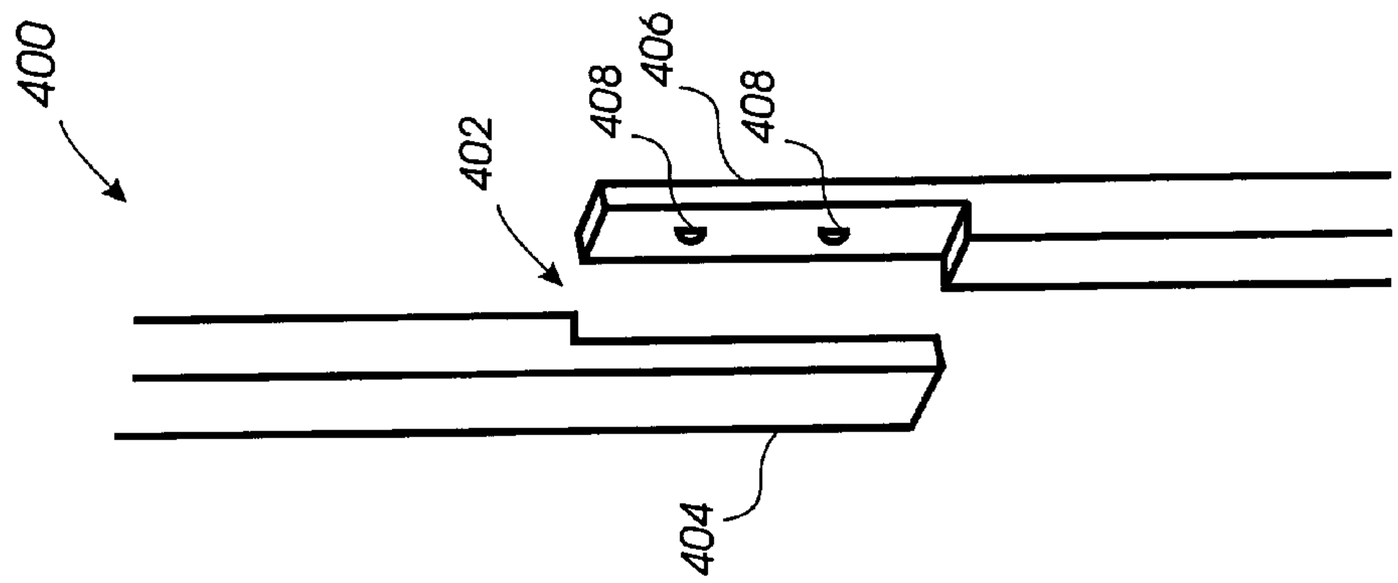


FIG. 4

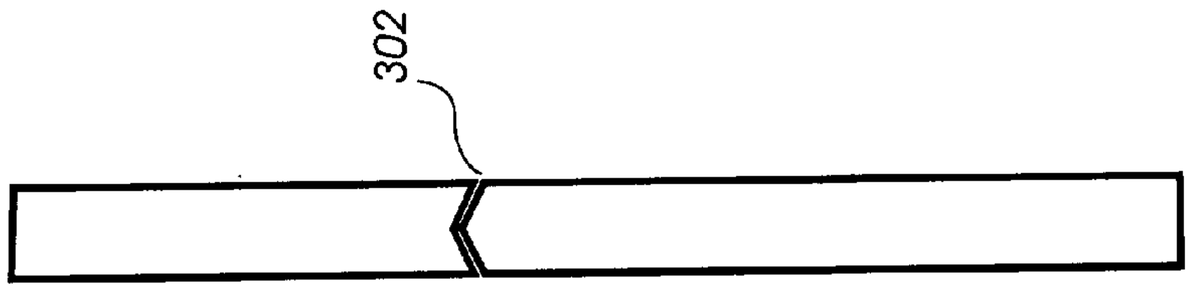


FIG. 3B

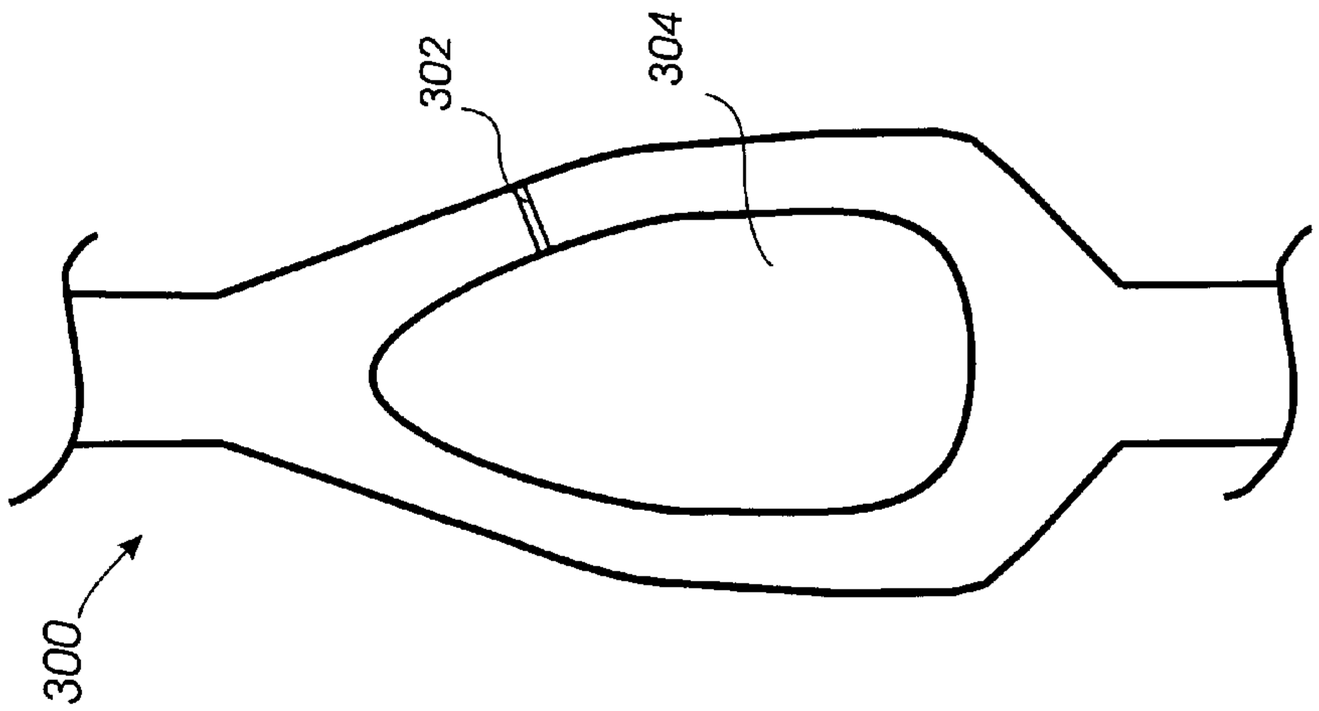


FIG. 3A

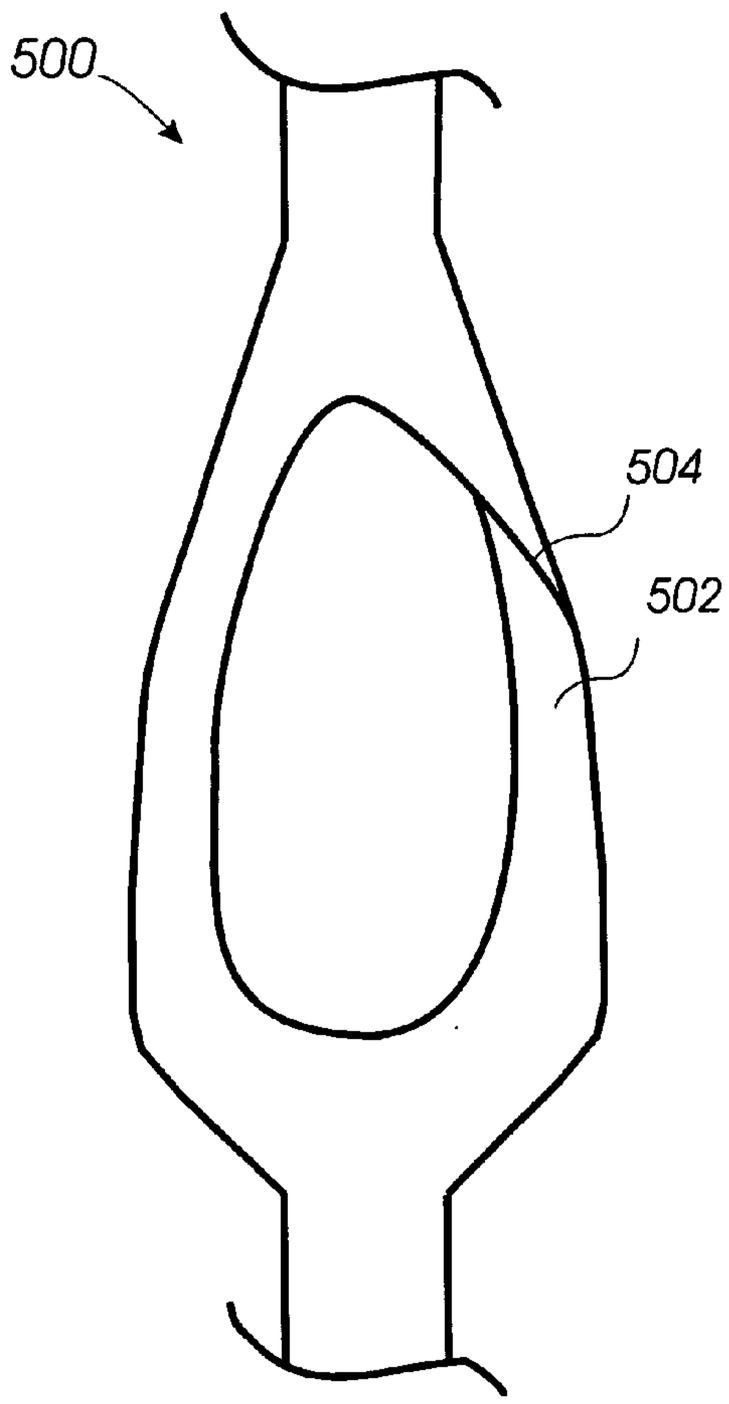


FIG. 5A

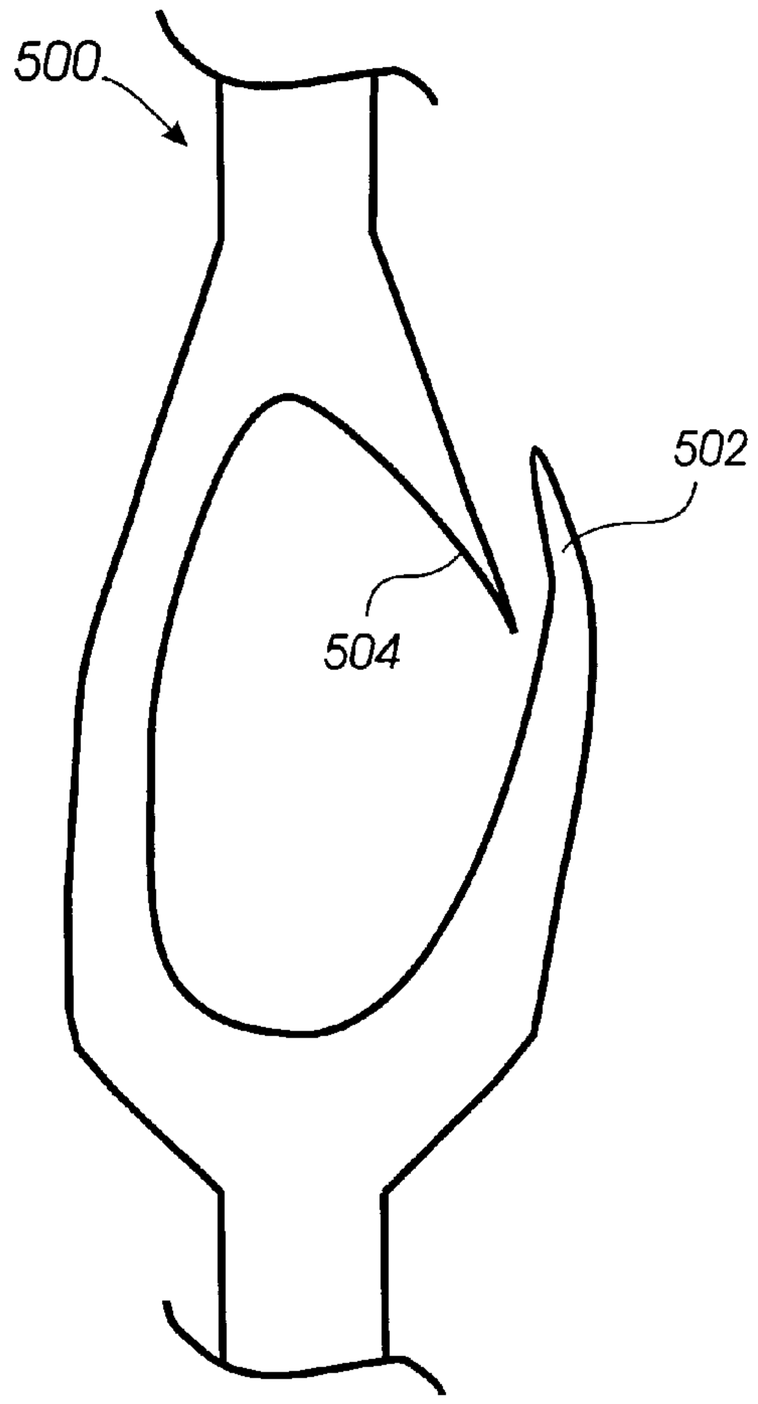


FIG. 5B

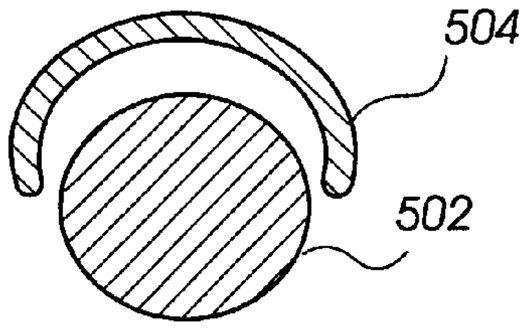


FIG. 5C

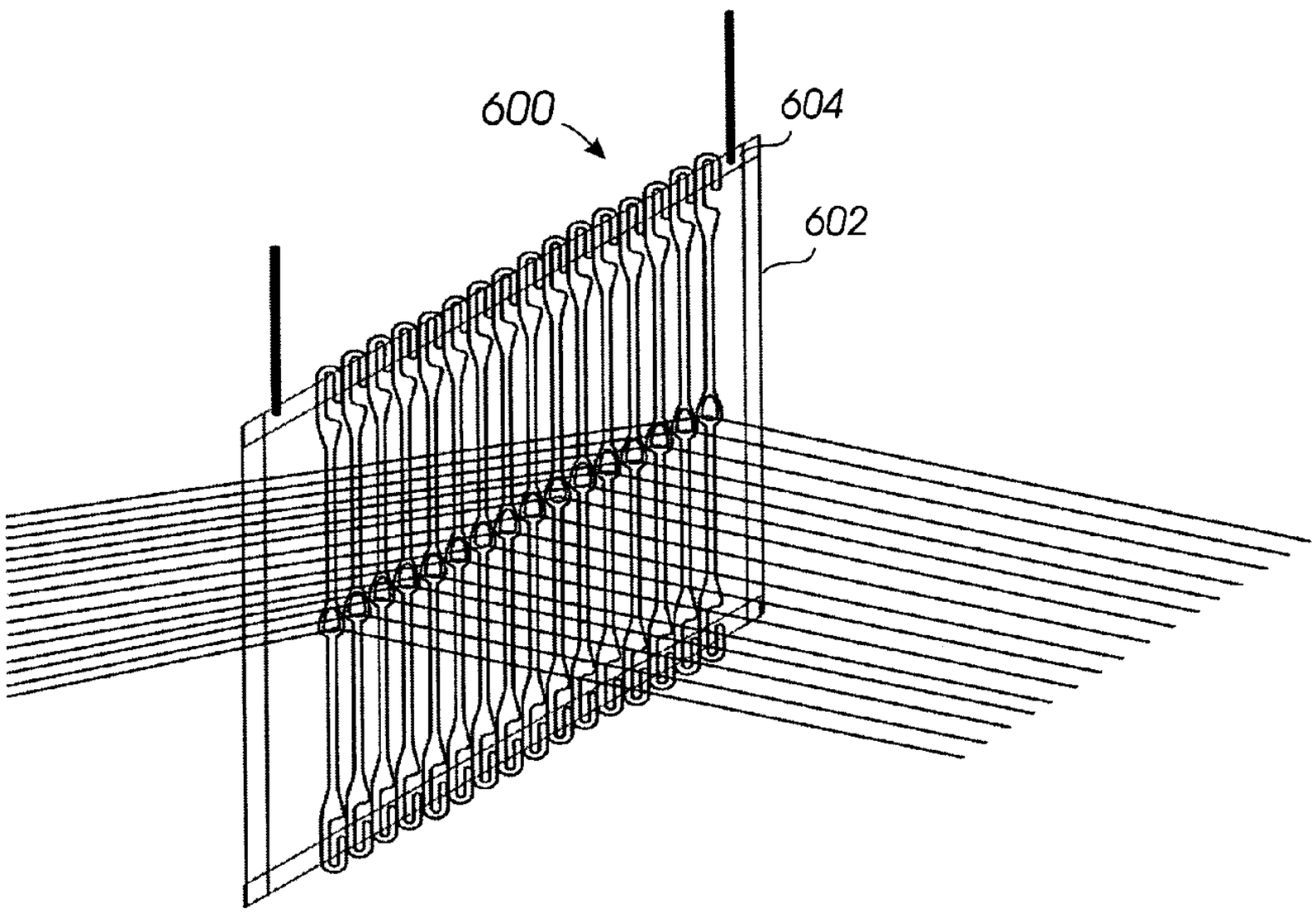


FIG. 6

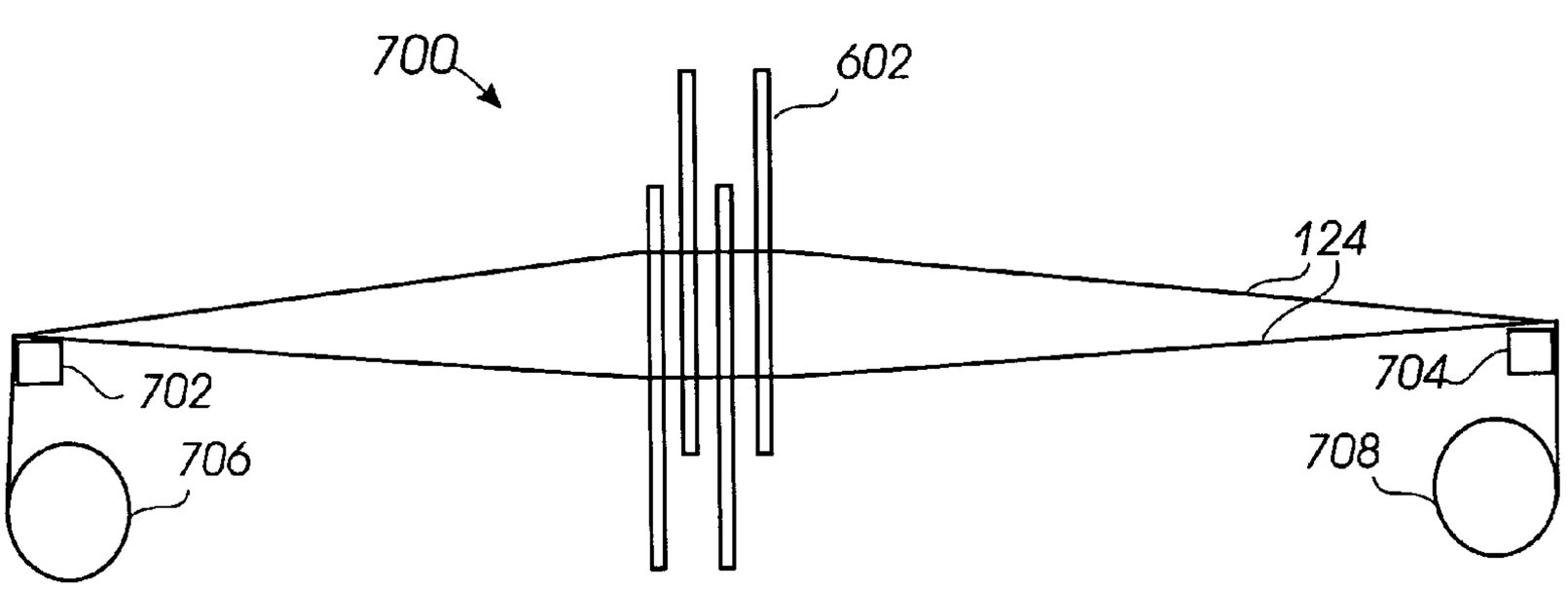


FIG. 7

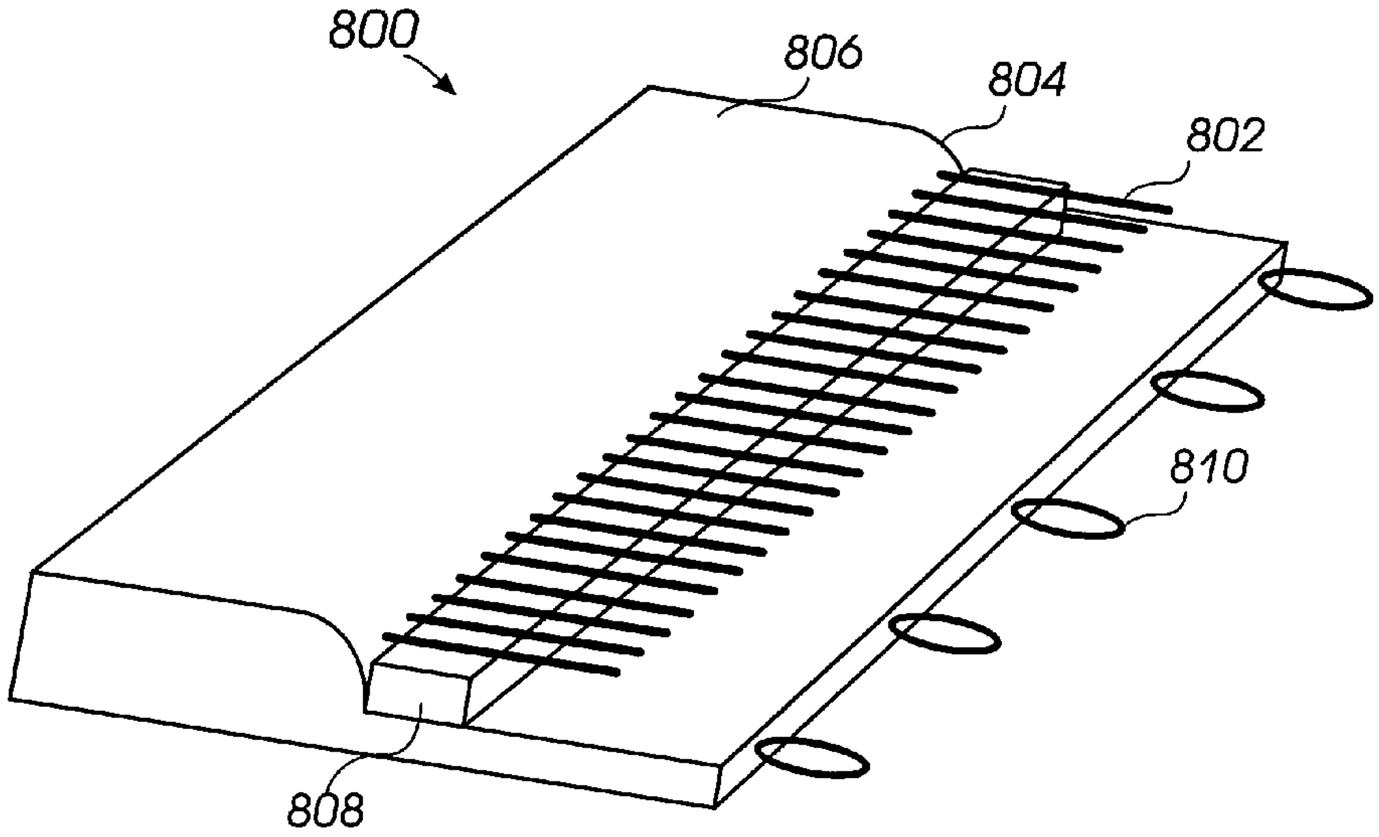


FIG. 8

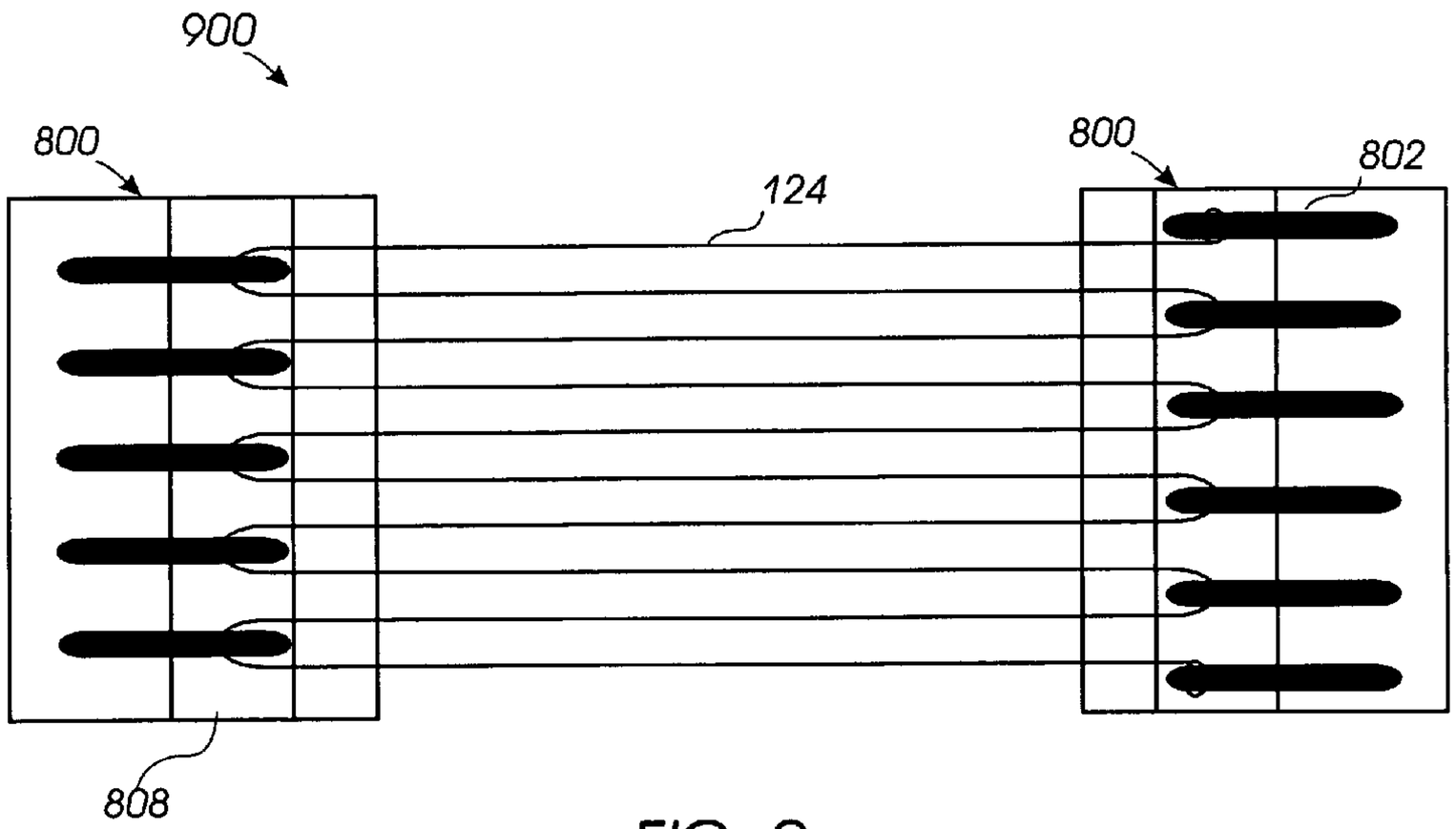


FIG. 9

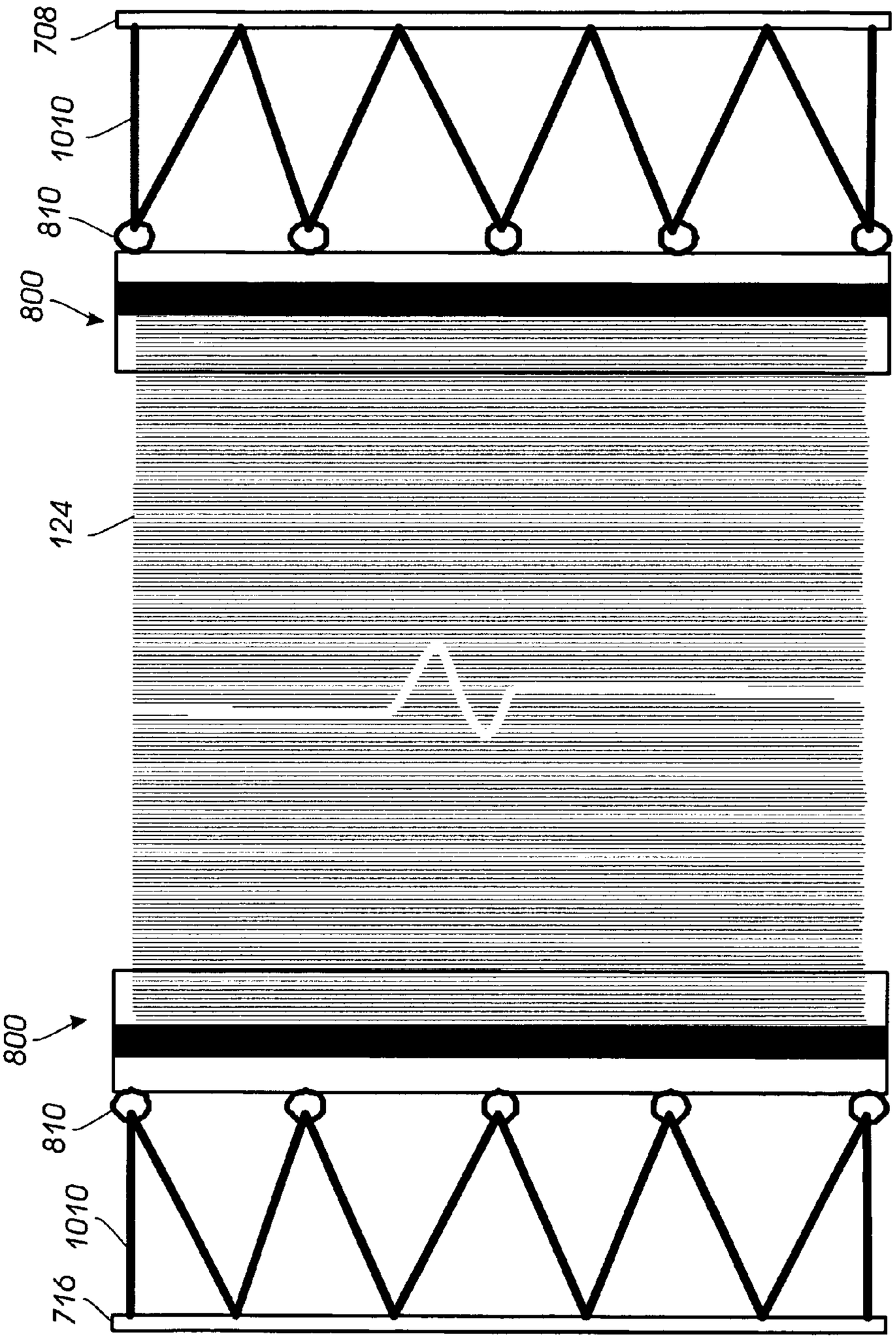


FIG. 10

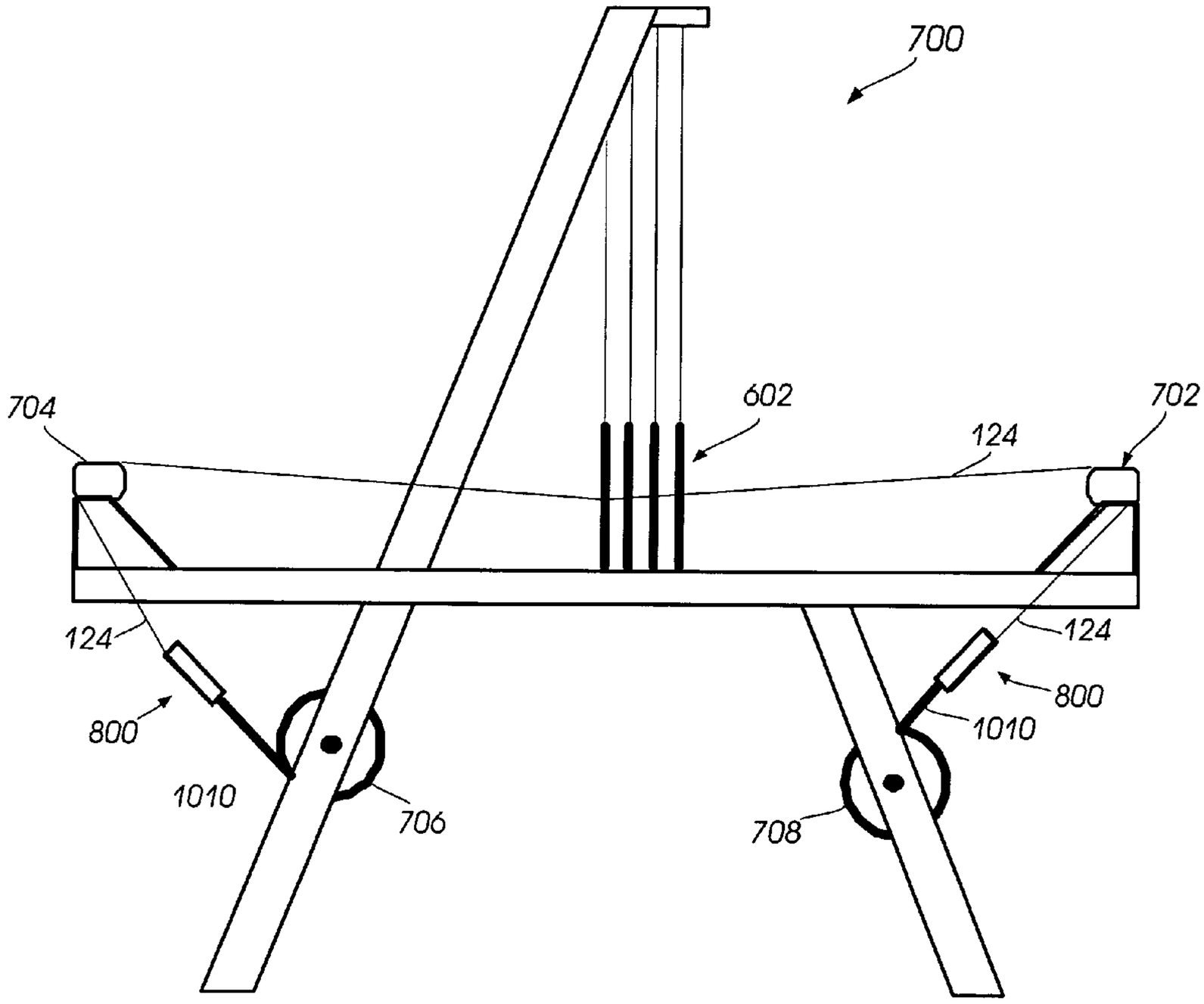


FIG. 11

APPARATUS AND METHOD FOR WARPING A LOOM

BACKGROUND

1. Technical Field

Embodiments of the invention relate to the field of warping looms in textile weaving and manufacturing.

2. Description of the Related Art

Since before the industrial revolution, the heddles used on handlooms have been similar in design. Heddles generally have a closed loop in the center through which the ends of warp threads are threaded. The top and bottom of the heddles have loops through which the heddles are attached to the harness or shaft frame. Heddles are typically made of polyester, twisted wire, or are pressed from sheet metal. Warp threads extend from a beam on one end of the loom, through a heddle, and attach to another beam at the other end of the loom.

One disadvantage of a closed loop heddle is that, once it is attached to the frame, it cannot be removed from the frame. Nor can the warp threads be removed from the heddles, once warping begins, since the warp threads are threaded through the heddle's center. Advanced weavers create complex weaving patterns using shaft switching. Shaft switching is the changing of the harness on which a single warp thread is moved. When switched to another harness, those warp threads can then change the pattern being woven. Shaft switching is not easily accomplished with conventional closed loop heddles. If a mistake is made during the warping process, all of the ends of the warp threads must be unthreaded back to the point at which the mistake was made to correct the problem. While some complex assemblies have been designed that open and close the eyelet of the heddle, the complex assemblies consist of several moving parts and are not readily adaptable to existing looms.

The warp beams or tie rods used on most handlooms are similar in design. The beams consist of a metal rod or wooden stick onto which the ends of the warp threads are tied. The traditional warp beams, and looms, do not provide any means to measure out the length of the warp threads. The warp beams are not meant to be used when removed from the loom. They also do not have means for maintaining a fixed distance between warp threads. The warp beams are seldom, if ever, removed from the loom. Clamps have been developed to attach warp thread to a beam without tying knots. However, the clamps have several disadvantages including multiple warp threads bunched together without separation, requiring drilling many holes into existing warp beams, having multiple parts, and using a series of springs with inconsistent tension on the warp threads across the beam.

Groups of 8 or more warp threads are typically tied to a warp beam in a single knot, which causes the threads to fan out from the knot to the heddles. The fan-out of the warp threads causes a scalloped edge at the beginning portion of a warp, and is referred to as the draw-in effect. For this reason, several inches of cloth must be woven before the scallops even out and the actual project may be started. This consumes time, adds to the amount of wasted material, and increases the overall length of the required warp.

An alternate means of attaching warp threads to a loom is to wind individual warp threads over a strip of adhesive on the beam and around the circumference of the beam. The disadvantages of this method include the potential for adhesive residue on the warp threads, potential release of the adhesive on one or more warp threads and attendant variations of tension, and a lack of positive and consistent control of the separation between warp threads. In addition, the method is not conducive to removal and replacement of the entire warp due to an inability to replicate the initial tension. This method also does not allow loading or removing the warp without removing all heddles from their frame.

Attaching the warp threads to the warp beams, also referred to as warping, in the traditional manner is very tedious. Traditional weavers usually install yards and yards of warp thread at one time. This permits the weaver to weave many projects before re-warping the loom. Unfortunately this means waiting until the entire warp is used before the individual projects can be removed from the loom. This can be especially frustrating for beginning weavers.

SUMMARY

It is therefore desirable to provide quick threading, openable heddles and a warp beam that provides even spacing of warp thread, even tension on the warp thread, and rapid set-up.

In some embodiments, a heddle for a weaving loom includes an eyelet with a break in the circumference of the eyelet. The break allows insertion and removal of a warp thread in the eyelet while both ends of the warp thread are attached to the weaving loom.

In other embodiments, a method of warping a loom includes positioning the warp thread against the periphery of an eyelet in the heddle; and moving the warp thread through a break in the periphery of the eyelet.

In still other embodiments, a warp beam includes a deck and a plurality of retaining members configured in spaced relationship to one another on the deck. Each retaining member retains a strand of warp thread that is substantially parallel to lines of warp thread retained by the other retaining members.

In further embodiments, a kit for retrofitting a loom includes a first warp beam and a second warp beam. The first and second warp beams include retaining members for retaining portions of warp thread in spaced apart substantially parallel relation, and the first and second warp beams are attachable to existing warp beams on the loom.

The foregoing has outlined rather broadly the features and technical advantages of embodiments of the present invention so that those skilled in the art may better understand the detailed description of embodiments of the invention that follows.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the present invention may be better understood, and their numerous objects, features, and advantages made apparent to those skilled in the art by referencing the accompanying drawings. The use of the same reference symbols in different drawings indicates similar or identical items.

FIG. **1**A is a front view of an embodiment of a heddle for threading warp thread in a loom.

FIG. **1**B shows detail of the eyelet portion of the heddle of FIG. **1**A.

FIGS. **1**C and **1**D show how a warp thread can be inserted in the eyelet of the heddle of FIGS. **1**A and **1**B without removing either end of a warp thread from a warp beam.

FIG. **2**A is a front view of another embodiment of a heddle that can be threaded without removing either end of a warp thread from a warp beam.

FIG. **2**B shows detail of the eyelet portion of the embodiment of the heddle shown in FIG. **2**A.

FIG. **3**A shows another embodiment of a heddle that can be threaded without removing either end of a warp thread from a warp beam.

FIG. **3**B shows a side view of the heddle of FIG. **3**A.

FIG. **4** shows a perspective view of another embodiment of a heddle that can be threaded without removing either end of a warp thread from a warp beam.

FIG. **5**A shows another embodiment of a portion of a heddle that can be threaded without removing either end of a warp thread from a warp beam.

FIG. **5**B shows the apparatus in FIG. **5**A in the open position.

FIG. **5**C is a cross-sectional view of a finger portion engaged in a channel portion of the heddle of FIGS. **5**A and **5**B.

FIG. **6** is a perspective view of a series of heddles installed on a frame.

FIG. **7** is a side view of loom components including frames and warp beams.

FIG. **8** is a perspective view of an embodiment of a warp beam.

FIG. **9** is a top view of a conceptual diagram of a warp utilizing the warp beams of FIG. **8**.

FIG. **10** is a top view of a loom utilizing the warp beams of FIG. **8**.

FIG. **11** is a side view of loom components including frames and the warp beams of FIG. **8**.

DETAILED DESCRIPTION

Embodiments of heddles and warp beams are disclosed that facilitate warping a loom by allowing the beams to be warped before being attached to the loom. Additionally, the warp threads can be threaded through an opening in the eyelets of the heddles while both ends of the warp thread remain attached to the warp beams.

Referring to FIGS. **1**A and **1**B, an embodiment of heddle **100** is shown with eyelet **110** that includes opening **112** in the circumference of eyelet **110**. Opening **112** allows warp thread to be inserted and removed without removing either end of the warp thread from a warp beam. In the embodiment shown, eyelet **110** is formed from a spiral loop **120** of material, such as plastic, metal, or other suitable material capable of substantially retaining its shape. In one embodiment, spiral **120** includes approximately one and one-half turns (coils) of material. Ends **122** of heddle **100** can include J-hooks or other fastening means to allow heddle **100** to be attached to, and detached from, a frame (not shown).

As shown in FIGS. **1**C and **1**D, heddle **100** can be threaded by raising one end **122** of heddle **100** to be substantially parallel to warp thread **124**. Warp thread **124** is positioned through opening **112** of spiral **120** and captured within eyelet **110** when end **122** of heddle **100** is lowered. The end **122** of heddle **100** can then be reattached to a frame.

FIGS. **2**A and **2**B depict another embodiment of a heddle **200** comprising an interlocking closure **202** in the circumference of eyelet **204**. The circumference of eyelet **204** is constructed from a flexible material, such as plastic, that allows bending of the ends of interlocking closure **202** in opposite directions to create an opening between adjacent portions of interlocking closure **202**. When interlocking closure **202** is open, warp thread **124** (FIG. **1**C) can be inserted into eyelet **204** without removing either end of the warp thread from a warp beam, as well as without detaching either end **122** of heddle **200** from a frame (not shown).

FIGS. **3**A and **3**B depict an embodiment of a portion of another heddle **300** including a V-shaped break **302** in the circumference of eyelet **304**. As shown in FIG. **3**B, one end of break **302** includes an inner V-shaped portion that engages an outer V-shaped portion of the other end of break **302**. The V-shapes retains the ends of break **302** in alignment during use of the loom. In some embodiments, a gap between the ends of break **302** allows a warp thread **124** (FIG. **1**C) to be inserted into eyelet **304** without removing either end of the warp thread from a warp beam and without removing heddle **300** from a frame (not shown). A user simply raises the warp thread to the gap in break **302**, and exerts a slight inward pressure against break **302** to force the ends of break **302** apart. A slight upward and downward movement, or vice versa depending on the orientation of the V-Shape of break **302**, may be required, depending on the height of the vertex of the V-shape. In some embodiments, the circumference of eyelet **304** is fabricated with a flexible material that allows the ends of break **302** to bend open to insert or remove warp thread **124**. The material is sufficiently elastic to return the ends of break **302** to a substantially closed position when released.

FIG. **4** depicts an embodiment of a portion of another heddle **400** with a break **402** that can be configured in the circumference of an eyelet (not shown) to allow warp thread **124** (FIG. **1**C) to be inserted and removed from the eyelet while the heddle remains attached to a frame, and the ends of warp thread **124** remain attached to the loom.

In the embodiment shown, break **402** includes two overlapping portions **404**, **406** formed or cut in the sidewall of the circumference of the eyelet. Overlapping portions **404**, **406** are fabricated from rigid material with flexible properties that allows overlapping portions **404**, **406** to be separated to insert and remove warp thread **124** from the eyelet, and return to their original position when released. In some embodiments, overlapping portions **404**, **406** can include a fastener to retain overlapping portions **404**, **406** in a closed position to retain warp thread **124** in the eyelet. The fastener can be disengaged to move overlapping portions **404**, **406** apart to remove warp thread **124** from the eyelet. An example of a fastener than can be used on overlapping portions **404**, **406** includes one or more protuberances **408** that are sized and shaped to snap into and out of corresponding indentation(s) (not shown) in overlapping portion **404**. Other suitable fasteners for opening and closing overlapping portions **404**, **406** can be utilized, in addition to, or instead of, protuberances **408** and corresponding indentations.

FIGS. **5**A and **5**B depict another embodiment of a heddle **500** that includes a finger portion **502** and channel portion **504**. Finger portion **502** is movable to engage channel portion **504** in a closed position, and to disengage channel portion **504** in an open position. Finger portion **502** can be moved to open or closed positions by exerting lateral force on the outer periphery of finger portion **502**. Any suitable angle can be utilized between finger portion **502** and channel portion **504** to help discourage warp threads **124** (FIG. **1**C) from snagging in the eyelet. FIG. **5**C is a cross sectional view of finger portion **502** engaged in channel portion **504**. Finger portion **502** and channel portion **504** can be formed by any suitable means such as extrusion, injection molding, or other fabrication process.

Referring now to FIG. **6**, heddles **100**, **200**, **300**, **400**, **500**, collectively referred to herein as heddles **600**, can replace closed heddles in most looms. Most frames **602** include a flat thin steel bar or rod **604** at the top and bottom of frame **602**. A series of heddles **600** are suspended onto rods **604**. The end portions of heddles **600** can be shaped to accommodate various frames **602**.

Referring now to FIG. **7**, loom **700** is shown with a plurality of frames **602**. Warp threads **124** are inserted through heddle eyelets (not shown) mounted in frames **602**. Warp threads **124** extend from front beam **702** through heddles in frames **602** to back beam **704**. During operation, frames **602** alternately raise and lower warp thread **124**. Typically, half of the frames **602** alternate with adjacent frames **602** between up and down positions. Back roller **706** is unwound to allow unwoven warp thread stored on it to move through the heddles, and front roller **708** winds up woven cloth.

Referring now to FIG. **8**, warp beam **800** includes a plurality of retaining members **802** protruding from a rounded edge **804** of deck **806**. Retaining members **802** retain parallel strands of warp thread **124** (FIG. **1**C) in a spaced relationship to one another, typically evenly spaced at intervals depending on the desired tightness of the weave. Alternatively, retaining members **802** can be relatively closely spaced, and a user can skip one or more alternating retaining members **802** to achieve the desired weave density. One advantage of warp beam **800** over known configurations is that retaining members **802** evenly space warp thread **124** over the width of the loom. The even spacing provides consistent warp tension, and produces more evenly woven material. A common spacing of retaining members **802** is five retaining members **802** per inch. Other spacing intervals can be used, however. Some embodiments of warp beam **800** include a plurality of attachment points **810** connected to deck **806**. Attachment points **810** can be eyebolts, snap hooks, hooks or other means for attaching warp beam **800** to various portions of loom **700**, either directly or by means of rope, hooks or other fastening material.

Referring to FIGS. **7**, **8** and **9**, a top view of a conceptual diagram of warp **900** includes parallel lines of warp thread **124** created by the consecutive back and forth winding of a single length of warp thread **124** between two spaced warp beams **800**. Warp beams **800** are typically used in pairs, and can be positioned the desired distance apart on a table or other surface, and "warped" by winding warp thread **124** between retaining members **802**. The warp beams **800** can be held in place during the warping process with C-clamps or other suitable attachment, with retaining members **802** facing outward. Warp **900** can then be fastened to existing front and back beams **702**, **704** on loom **700**. Alternatively, warp beams **800** can be fastened to loom **700** before installing warp thread **124** on retaining members **802**. Once warp **900** is completed, each parallel line of warp thread **124** can be inserted through a corresponding heddle **600** (FIG. **6**).

Warp beams **800** can include warp thread attachment points to retain the ends of warp thread **124**. The ends of warp thread **124** can be tied or otherwise fastened to retaining members **802**, or other suitable structure. In one embodiment, a knot is tied in warp thread **124** to fasten the end of warp thread **124** to one of retaining members **802**, or other suitable structural component on warp beam **800** or loom **700**. In alternate embodiments, the ends of warp thread **124** can be adhesively attached, positioned in a notch, or clamped to warp beam **800**. In some situations, for example in the production of multi-colored or striped material, more than two attachments for the ends of warp threads **124** may be required. In such embodiments, different warp threads **124** can be wound on warp beam **800**, with each end of warp thread **124** being attached to an intermediate retaining member **802**, or other suitable structural component, on warp beam **800**.

A single length of warp thread **124** can be used to warp loom **700** by winding warp thread **124** in consecutive parallel lines between two spaced apart warp beams **800**. Accordingly, parallel lines of warp thread **124** are evenly spaced over their entire length between warp beams **800**, and very few knots or other means for attaching warp threads **124** are required. The even spacing between parallel lines of warp thread **124** over their entire length eliminates the "draw-in effect" found on conventional looms, which is caused by attaching multiple warp threads **124** to one location on a warp beam.

In some embodiments, warp thread **124** is attached to warp beam **800** by inserting a portion of warp thread **124** between retaining members **802** and retention strip **808**. Retention strip **808** can be fabricated with elastic material capable of deflecting when warp threads **124** are inserted around portions of the retaining members **802**. Retention strip **808** substantially maintains to its original shape to provide compressive force on warp thread **124** against retaining members **802**. Retention strip **808** can be positioned adjacent retaining members **802** to keep warp thread **124** in place by providing compression against the portion of warp thread **124** positioned between retaining members **802** and retention strip **808**.

Sufficient tightness of retention strip **808** is typically developed to hold the warp thread in place if warp thread **124** breaks. Alternatively, a strip of adhesive tape or other retention mechanism placed under and over the ends of warp thread **124**, adjacent to retention strip **808**, can retain warp thread **124** in the event of a break.

In some embodiments of warp beam **800**, retaining members **802** comprise snap hooks or other suitable fasteners that grasp a portion of warp thread **124**. Such embodiments may not require retention strip **808**. Retaining members **802** can be spring-mounted to create consistent tension between parallel lines of warp thread **124**. Further, certain types of fasteners such as snap hooks can be used as retaining members **802** to reduce or even eliminate the need to tie knots in warp thread **124** to attach the ends of warp threads **124** to retaining members **802**. The snap hooks, or other fasteners, can be installed at any desired spacing along warp beam **800**.

Warp beams **800** can be attached to loom **700** (FIG. **7**) using large metal snap hooks or other suitable fasteners. Fasteners may be attached to the loom's original warp beam or to ropes used to secure the original warp beams **702**, **704** to loom **700**. Warp beams **800** can be strapped or tied to existing warp beams **702**, **704**, or attached with a variety of mating interlocking mechanisms, such as hooks and eyes, and dovetails. Other suitable attachment means may also be used to attach warp beams **800** to loom **700**.

Referring now to FIGS. **7**, **8**, **9**, **10** and **11**, alternate embodiments of warp beams **800** can be attached to loom **700** using attachment points **810**. (In FIG. **10**, front beam **702** and back beam **704** have been removed for clarity.) In one embodiment, attachment point **810** comprises an eyebolt through which attachment media **1010** is threaded. Attachment media **1010** is typically comprised of nylon rope when it is used to attach a tie rod in traditional looms. However, attachment media **1010** could be made of other suitable material, such as rope, chain, or twine. One section of attachment media **1010** attaches a first warp beam **800** to roller **706**, and another section of attachment media **1010** attaches the other warp beam **800** to roller **708**. In some embodiments, many yards of warp thread **124** are suspended between two warp beams **800**. Excess warp thread **124** can then be wound around back roller **706**, together with one warp beam **800** at the beginning of weaving, and then unwound as needed in the weaving process. Later, the completed cloth would follow the first section of attachment media **1010** and the front warp beam **800** as they are all wound onto front roller **708**.

A loom assembly that includes warp beams **800** and heddles **600** can be warped in much less time than conventional looms. The various alternate embodiments of heddles **600** described herein enable warp threads **124** to be threaded through heddles **100** after the entire warp **900** is attached to loom **700**. Additionally, warp beams **800** and heddles **600** enable different warps **900** to be easily interchanged to switch weaving projects before the projects are finished. The various embodiments of heddles **600** also allow warp thread **124** to be removed without removing either end of warp thread **124** from loom **700**. Once unthreaded, individual heddles **600** can be removed from frame **602** while the rest of warp **900** remains intact on loom **700**. Heddles **600** also allow shaft switches to be easily made to create complex weaving patterns.

Unlike conventional closed loop heddles, embodiments of heddles **600** can easily be inserted or removed from frame **602**. Instead of threading ends of warp thread **124** through eyelets with closed circumferences, the weaver can lift warp thread **124** that has already been warped on the loom, and insert it through an opening in heddle **600**. Warp threads **124** can be reinserted in heddles **600** while warp thread **124** remains attached to front and back warp beams **800** (or **702**, **704**) on loom **700**.

While the invention has been described with respect to the embodiments and variations set forth above, these embodiments and variations are illustrative and the invention is not to be considered limited in scope to these embodiments and variations. Accordingly, various other embodiments and modifications and improvements not described herein may be within the scope of the present invention, as defined by the following claims.

What is claimed:

1. A kit for retrofitting a loom, comprising:

a first warp beam;

a second warp beam, wherein the first and second warp beams include retaining members for retaining portions of warp tread in spaced apart substantially parallel relation between the first warp beam and the second warp beam, and the first and second warp beams are attachable to and removable from the loom while the warp thread is retained between the retaining members;

a pluralitv of attachment points connected to the deck to attach the warp beam to a loom; and

a deck on the first and second beams, wherein the retaining members are configured in spaced relationship to one another on the deck.

2. The kit of claim **1**, further comprising:

a heddle comprising an eyelet, wherein the eyelet includes an openable break in the circumference of the eyelet, and the openable break allows insertion and removal of a warp thread through the eyelet while the ends of the warp thread remain attached to the first and second warp beams.

3. The kit of claim **1** wherein the retaining members are spring-mounted to maintain substantially consistent tension on the warp thread.

4. The kit of claim **1**, further comprising a retention strip, wherein the retention strip is positioned to exert compressive force on the warp thread to help retain the warp thread relative to the retaining members.

5. The kit of claim **1**, further comprising a retention strip positioned adjacent to the retaining members.

6. The kit of claim **5**, wherein the retention strip is fabricated with elastic material capable of deflecting when the warp threads are inserted around the retaining members, and returning to substantially original shape.

7. The kit of claim **2**, wherein a spiral loop between the ends of the heddle comprises an eyelet, and overlapping portions of the spiral loop comprise the break, and the warp thread can be inserted in the eyelet when the heddle is positioned substantially parallel to the warp thread.

8. The kit of claim **2**, wherein the break comprises a V-shaped cut in the circumference of the eyelet.

9. The kit of claim **2**, wherein the break comprises a split between two overlapping portions of the circumference of the eyelet.

10. The kit of claim **9**, further comprising a fastener operable in a closed position to retain the overlapping portions together, and to allow the overlapping portions to be moved apart in an open position to allow the warp thread to be inserted and removed from the eyelet.

11. The kit of claim **10**, wherein the fastener comprises at least one protuberance on one of the overlapping portions that engages a corresponding indentation on the other overlapping portion.

12. The kit of claim **2**, wherein the break comprises an interlocking snap closure.

13. The kit of claim **2**, wherein one end of the break comprises a movable finger portion, and another end of the break comprises a channel portion configured to engage the finger portion in a closed position.

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